EX PARTE OR LATE FILED

GTE

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April 7, 1997

Mr. William Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W. - Room 222
Washington, D.C. 20554

Ex Parte: CC Docket 96-45, Federal-State Joint Board on Universal Service

Dear Mr. Caton,

The attached letter from William P. Barr, Senior Vice President and General Counsel of GTE Corporation, was delivered today to Chairman Reed E. Hundt regarding GTE's universal service funding requirements. A description of the methodology and cost detail supporting GTE's universal service estimate was provided to the Chief, Common Carrier Bureau and her staff. A copy of this material is enclosed.

In addition, representatives of GTE met today with Ms. Kathleen Levitz and Mr. Timothy Peterson of the Common Carrier Bureau to discuss GTE's positions on universal service, its estimated funding requirement, and the attached paper on the *Validation of Proxy Cost Models*, by Christensen Associates.

Please call me at (202) 463-5293 if you have any questions concerning this filing.

Sincerely,

W. Scott Randolph

W. Scott Randolph
Director - Regulatory Affairs

cc: Ms. Kathleen Levitz
Mr. Timothy Peterson
Ms. Jeanine Poltronieri
Mr. Bob Loube
Mr. William Sharkey

William P. Barr
Senior Vice President
and General Counsel

GTE Corporation

1850 M. Street, N.W.
Suite 1200
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202 463-5200

April 7, 1997

The Honorable Reed E. Hundt
Chairman
Federal Communications Commission
1919 N Street, NW
Washington, DC 20554

Dear Chairman Hundt:

Several weeks ago we discussed the importance of basing the funding of universal service on local exchange carriers' actual costs, including any depreciation reserve deficiency, and targeting universal service funding requirements on that basis. In response to your question about GTE's universal service funding requirements, I am attaching such a summary.

Assuming a federal funding benchmark of $30 for residential single party service, GTE's estimated, federal universal service funding requirement is $1.51 billion based on actual costs less the depreciation reserve deficiency. If a federal benchmark of $20 is employed, GTE's federal universal service funding requirement would be $2.52 billion. This $20 benchmark level is roughly equal to the nationwide average, residential, local service charge, as recently calculated by the FCC. Therefore, $2.52 billion represents a conservative proxy for GTE's total universal service funding requirement. Inasmuch as these funding requirements are implicit in our rates today, establishing explicit funding of these amounts would permit us to make off-setting rate reductions of as much as $2.52 billion to our customers paying subsidy-laden services.

GTE is not opposed to determining universal service support based on the use of an adequate "forward-looking" cost methodology so long as: i) any subsidies required are funded on an explicit and competitively neutral basis, ii) the depreciation reserve deficiency associated with traditionally regulated depreciation rates is recovered through an "outboard" mechanism, and iii) prospective costs are based on our actual investment, operating expenses, and operating practices.

For reasons described in our comments, GTE does not believe that any of the existing "proxy" models should be used to estimate the level of forward-looking cost. However, the approach used in the attached analysis combines data on GTE's actual costs with information from a proxy model concerning the relative cost of serving different small areas. We believe that this approach has merit as a practical method for implementing the Joint Board's recommendation. Federal funding would cover any requirement above a federal benchmark and state universal service funding mechanisms would eliminate any remaining implicit subsidies between existing local rates and the federal benchmark.

I believe this information is responsive to the question you raised several weeks ago. We look forward to a Commission decision that recognizes GTE's actual cost of providing universal service and provides sufficient explicit funding in the many high cost areas where GTE and other companies provide service. Detail supporting the attached summary is being filed today with the Chief of the Common Carrier Bureau and in the record of this proceeding.

Please let me know if you have any questions.

Sincerely,

W Barr

William P. Barr

Attachments

c: Commissioner Rachelle B. Chong
Commissioner James H. Quello
Commissioner Susan Ness
Regina Keeney
Larry Atlas
Kathleen Levitz
Richard Metzger
Jeanine Poltronieri

DISTRIBUTION OF ACTUAL COST AND PROJECTION OF UNIVERSAL SUPPORT USING THE BENCHMARK COST PROXY MODEL (BCPM) TO ACCOMPLISH THE DISTRIBUTION

GENERAL DESCRIPTION

The goal of GTE's study was to identify the actual cost of providing local service and distribute this cost to census block groups (CBGs) to provide a foundation for determining targeted universal service support requirements. To accomplish this task, the BCPM model was employed to allocate the actual cost to CBGs. GTE then calculated the amount of universal service support required when compared to potential national benchmarks.

SUMMARY OF STUDY METHODS

GTE's current costs may differ from forward looking costs to the extent that they include cost recovery deferred from previous periods because of depreciation methods GTE has been required to use. To recognize this and to derive its cost of providing universal service, GTE reduced its total company Part 32 actual net book investment by $7.1 billion. This reduction represents unrecovered investment associated with the reserve deficiency as quantified in GTE's CC Docket No. 96-262 (Access Charge Reform) comments. The resulting basic service cost per line should approximate GTE's "going forward" costs. GTE also reflected certain Part 36 Rule changes (reclassification of Pay Telephone to non-regulated, allocation of Other Billing and Collection Expense, etc.). On a study area basis this restated Part 32 loop and local switching cost per line reflects GTE's actual operating expense, return and taxes based on the adjusted investment. The components of loop, local switching and local transport cost which make up basic service contained in this analysis are consistent with the Joint Board's universal service recommendation.

Once the study area level of cost was derived, it was allocated to CBGs on the basis of either lines or gross investment using the BCPM model. Customer Operations Expense (Account series 6600) and Corporate Operations Expense (Account series 6700) amounts were allocated to the CBGs on the basis of total lines. These expenses are more a function of lines than investment; i.e., CBGs with higher gross investment do not require more marketing, product management, accounting or legal expense than CBGs with low gross investment. All costs other than Customer and Corporate Operations expense were allocated to the CBGs based on gross investment.

GTE's universal service support requirement was estimated by quantifying any CBG cost in excess of a $30 residential single party benchmark and a $45 single line business benchmark and multiplying the difference by the number of qualifying single lines. This analysis was also performed assuming a $20 residential single party benchmark and a $45 single line business benchmark.

GTE TELEPHONE
UNIVERSAL SERVICE REQUIREMENT

STATE	Basic Local Actual Cost (a)	W/ FASB #71 Reserve Adjustment Actual Cost/Mo/Ln (b)	Res/Bus. Single Line USF Support (d)
Alabama	$117,192,541	$38.71	$28,674,076
Alaska	N/A	N/A	N/A
Arizona	4,013,111	44.04	819,885
Arkansas	84,754,796	36.49	20,620,391
California	1,824,941,389	37.43	334,639,677
Florida	961,225,460	39.78	151,752,749
Hawaii	360,550,279	44.07	93,902,811
Idaho	56,947,149	40.77	16,649,031
Illinois	271,658,019	26.72	44,048,288
Indiana	362,230,425	34.63	79,262,672
Iowa	99,439,540	39.91	17,320,395
Kentucky	233,652,962	39.60	62,696,036
Michigan	266,527,794	32.07	52,082,473
Minnesota	46,670,118	33.26	9,193,624
Missouri	191,857,668	39.91	53,241,808
Nebraska	19,242,276	29.36	4,174,484
New Mexico	35,752,107	36.78	9,340,728
Nevada	10,365,320	29.57	2,243,568
N. Carolina	155,984,393	43.73	41,544,850
Ohio	292,985,210	30.69	50,976,607
Oklahoma	45,523,763	37.19	11,371,213
Oregon	165,767,177	33.82	30,271,332
Pennsylvania	214,474,917	29.75	42,085,683
S. Carolina	86,833,294	39.82	22,615,722

GTE TELEPHONE

UNIVERSAL SERVICE REQUIREMENT

STATE	Basic Local Actual Cost (a)	W/ FASB #71 Reserve Adjustment Actual Cost/Mo/Ln (b)	Res/Bus. Single Line USF Support (d)
Texas	791,438,197	39.56	184,675,829
Virginia	210,067,717	35.33	48,531,524
Washington	323,653,074	36.77	67,390,585
Wisconsin	170,913,693	31.66	31,490,592
Saipan	N/A	N/A	N/A
Total Data Available	**$7,404,662,389**	**$36.48**	**$1,511,616,633**
% of Companies Reported	**99.82%**		**99.82%**
Estimated GTE Corporation	**$7,418,014,816**		**$1,514,342,449**

Validation of Proxy Cost Models

Christensen Associates
April 4, 1997

I. Introduction

Proxy cost models are currently being considered in various FCC proceedings as a tool for determining universal service support payments, access rate restructuring, and unbundled network element pricing. On January 9, 1997, members of the FCC staff ("Staff") issued an analysis to stimulate discussion on the criteria for the evaluation of forward-looking proxy cost models.[1] We responded to the Staff Analysis on behalf of the United States Telephone Association. Among our conclusions was that validation of the proxy models must include an assessment of how well the models relate to the costs of a dynamically efficient actual telephone company—i.e., "external validation" is required.[2] Comparing and standardizing the results of one proxy model relative to another proxy model (i.e., "internal validation") is not sufficient to ensure meaningful results.

In this paper, we compare the results of the latest versions of the proxy cost models—Benchmark Cost Proxy Model (BCPM) and Hatfield Release 3.1 (HM3.1)—with the forward-looking costs of an actual market participant.[3]

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[1] "The Use of Computer Models for Estimating Forward-Looking Economic Costs," FCC Staff Analysis, January 9, 1997. Hereafter referred to as "Staff Analysis."
[2] "Appropriate Standards for Cost Models and Methodologies," Christensen Associates, February 13, 1997. Attached to Comments of the United States Telephone Association, CCB/CPD Docket No. 97-2, February 18, 1997.
[3] In this paper, we report results for the February 22, 1997 release of BCPM and the March 3,1997 release of HM3.1.

Namely, we compare the proxy model results to estimates of economic costs for GTE study areas in various states. We find that GTE's costs are overestimated by 7 percent, on average, by BCPM and are underestimated by 37 percent, on average, by HM3.1. Therefore, on average, BCPM comes closest to estimating GTE's economic costs. However, there is a great degree of variation of proxy results relative to GTE costs on a state-by-state basis. The degree of proxy model deviation from GTE costs varies by the size of GTE's serving territory in a state and the level of economic cost for the GTE serving area. The degree of BCPM overestimation is smaller in larger states while the degree of HM3.1 underestimation is larger in larger states. Before discussing these results, we review the concept of forward-looking economic costs and its appropriate application to the LEC industry.

II. Background - Forward-Looking Economic Costs

In paragraph 9 of the Staff Analysis, they define forward-looking economic costs as "the costs that would be incurred if a new element or service were provided, or that could be avoided if an existing element or service were not provided, assuming that all input choices of the firm can be freely varied."[4] Staff asserts that they believe this definition is consistent with the Federal-State Board on Universal Service's ("Joint Board") conclusion that universal service support should be based on forward-looking economic costs of an efficient carrier."[5] The

[4] Staff Analysis, p. 4.
[5] Id.

economic criteria spelled out by the Joint Board are based on forward-looking economic costs to determine the cost of providing universal service:[6]

> "We find that forward-looking economic costs should be used to determine the cost of providing universal service. Those costs best approximate the costs that would be incurred by an efficient competitor entering the market. We believe that support should be based on the cost of an efficient carrier and should not be used to offset the cost of inefficient provision of service...."

Implementing these principles raises a number of fundamental questions. A key issue in guiding the development of cost models is the interpretation of what constitutes forward-looking economic costs, regardless of whether they relate to incremental or joint and common costs. The appropriate interpretation is the expected costs of an actual market participant.

As we pointed out in our previous analyses of proxy cost models,[7] a common, but incorrect, interpretation of this principle is that the entrant will provide the full array of services currently provided by the incumbent LEC, but the entrant has no sunk investment and therefore is not constrained by past decisions in its network investments—i.e., the entrant starts with a "blank slate" and instantaneously constructs a network with the capacity to accommodate all of the incumbent's customers. This interpretation of the efficient entrant represents an unattainable static model, rather than the achievable performance of an efficient incumbent or entrant. Actual incumbents or entrants will generally

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[6] Federal-State Board on Universal Service, CC Docket 96-45, Recommended Decision, November 8, 1996, para 270.
[7] Supra, n. 2, and "Economic Evaluation of Proxy Cost Models for Determining Universal Service Support," Christensen Associates, January 9, 1997.

deviate from this hypothetical static standard because of uncertainty, the capital intensive nature of the telecommunications industry, and its rapid rate of technological change. Therefore, holding actual firms to this hypothetical standard will lead to an under-recovery of costs by an efficient incumbent.

Examples from the economic literature support the view that the appropriate basis for determining forward-looking economic costs (and, hence, the prices based upon these costs) is the expected costs of an actual firm in the market and not the instantaneous entrant. In his seminal article on marginal cost in the highly regarded Economic Journal, Turvey notes that at any point in time, the costs of a firm or industry represent a mixture of plant vintages and that costs derived from replacing the industry from scratch are irrelevant:[8]

> "New plants reflect current technology and changing relative factor prices and will be built when price exceeds their average total costs. The oldest plants are scrapped when they fail to cover their operating costs. In between come a whole range of plants of various vintages. Thus the cost structure of the industry in any year depends upon the past evolution of its gross investment, its technology and relative factor prices.
>
> This brings out the general irrelevance of the traditional long-run average-cost curve for the whole industry. Such a curve shows what costs would be at various alternative levels of output if the industry were built from scratch using to-day's technology and minimising costs at to-day's relative factor prices. This is clearly irrelevant in most cases."

This passage states that the appropriate cost recovery target should be total costs as they are computed from the various plant vintages, and not costs

[8] Ralph Turvey, "Marginal Cost," The Economic Journal, June 1969, pp. 285-286. For examples specific to the telephone industry, see William E. Taylor, "Efficient Pricing of Telecommunications Services: The State of Debate," Journal of Industrial Organization 8, 1993.

based on a hypothetical firm or industry built from scratch.

In a January 14, 1997 letter to FCC Chairman Reed Hundt, Professor Alfred E. Kahn responded to a December 2 letter by five former Department of Justice Economists who declared their support for TELRIC-based pricing. Professor Kahn declared he was in "fundamental disagreement" with them for a number of reasons. One of the fundamental disagreements Professor Kahn has is the interpretation of economic costs as being developed from a "blank slate" versus the actual expected costs of an existing firm: Professor Kahn argues that the appropriate standard is the costs that will actually be incurred, not those of a hypothetical entrant who instantaneously builds its capacity from a "blank slate."[9]

> "Advocates of the 'blank slate' version of TELRIC typically assume that that is the level to which competition would drive price, if it were effective. They are mistaken. In a world of continuous technological progress it would be irrational for firms constantly to update their facilities in order <u>completely</u> to incorporate today's lowest-cost technology, as though starting from scratch: investments made today, totally embodying <u>today's</u> most modern technology, would instantaneously be outdated tomorrow and, in consequence, never earn a return sufficient to justify the investments in the first place."

The hypothetical statically efficient entrant interpretation does not represent the performance of an actual entrant or incumbent who is dynamically efficient. Because of uncertainty, the capital intensive nature of the telecommunications industry, and its rapid rate of technological change, a model based on the hypothetical statically efficient entrant will not accurately model the performance of dynamically efficient actual entrants or incumbents. Indeed, the

[9] Letter from Alfred E. Kahn to Reed E. Hundt, January 14, 1997, pp 1-2.

investments developed by a static model will not generally be the ones that would minimize the firm's cost over the long run. An entrant that built enough capacity at the outset to serve the entire market, or an incumbent that entirely replaced its plant whenever technology changed, would have higher costs than a firm that added optimal increments of investment over time. The "blank slate" scenario appears to be efficient in the context of the static model, but that is only because the model does not include the tradeoffs an actual firm must consider in a dynamic cost minimization.

Therefore, if rates were strictly based on the cost levels produced from models adhering to the hypothetical standard of instantaneous static efficiency, cost recovery problems would be created for both incumbent LECs and actual market entrants. Moreover, as Professor Kahn notes, adopting a "blank slate" approach will actually discourage facilities-based competition in contrast to the FCC's goals:[10]

> "In either event, the Commission's prescription reflects a presumption all too typical of regulators—declaring, in effect, 'we will determine not what your costs <u>are</u> but what they <u>ought</u> to be.' That approach has two major defects: first, that is not how the competitive process works; and second, its prices would actually discourage competitors coming in and building their own facilities when that would be more efficient than using the incumbent's facilities...."

[10] Kahn letter, p. 2.

In its comments on Staff's analysis, GTE also points out that the "blank slate" interpretation of long-run economic costs is not an appropriate one for an efficient incumbent or entrant:[11]

> "The long-run forward-looking cost of a firm in a competitive market can be developed only with reference to the dynamic 'cost minimization problem,' and must take into account factors such as growth, changes in input prices, indivisibilities, and constraints on the availability of investment capital. ... the firm will have a mix of older and newer technologies, and some equipment will have high utilization rates whereas other equipment will have lower rates. This does not mean, however, that the firm is inefficient; indeed, the contrary is true, for this 'technology mix' is part of the firm's overall solution to the cost minimization problem."
>
> "A firm entering the telecommunications market will be more efficient than an incumbent only if it solves the fundamental business 'cost minimization problem' better, over time than the incumbent does. For example, better forecasting would reduce the cost of uncertainty, and exclusive access to a new technology might reduce the indivisibility problem. But there is nothing inherent in being an entrant that would automatically allow one firm to solve the 'cost minimization problem' better than an incumbent."

Finally, it is somewhat of a paradox that the telephone industry, which has been at the forefront of technological innovation over the years, would be held to this hypothetical static efficiency standard. Our productivity studies, as well as those of others, have shown that the telephone industry has consistently surpassed most other industries in its rate of productivity growth.[12] If any

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[11] GTE's Comments," CCB/CPD 97-1, February 18, 1997, pp. 16-17.

[12] Most productivity studies of the telephone industry have focused either on the Bell System (pre-1984), or Bell Operating Companies and other Tier 1 LECs (post-1984). For example, see Laurits R. Christensen, Philip E. Schoech, and Mark E. Meitzen, "Productivity of the Local Operating Telephone Companies Subject to Price Cap Regulation," Christensen Associates, May 3, 1994; ________ "Total Factor Productivity Methods for Local Exchange Carrier Price Cap Plans," December 18, 1995. A review of other telephone industry TFP studies can be found in Prepared Testimony of Laurits R. Christensen, Public Utilities Commission of the State of California Investigation No. 95-05-047, September 8, 1995.

industry represents a model of dynamic efficiency, it would be the telephone industry. Therefore, the costs that are expected to be incurred by incumbent providers would provide a good benchmark to assess the forward-looking economic costs for telecommunications providers.

III. External Validation of Proxy Models

While the standardization of proxy model input values may bring their statewide average results closer together and achieve greater "proxy-to-proxy" consistency,[13] the key question is how well these costs relate to those of a dynamically efficient actual firm. This is important at both the study area level and at a disaggregate level, such as wire center or Census Block Group, if this is how Universal Service funds are to be disbursed. In this section, we compare proxy model results with the actual forward-looking economic cost estimates from various GTE study areas. We term this exercise "external validation."

To determine GTE's economic costs, booked capital values (i.e., telephone plant in service) provide a starting point, but need to be adjusted to reflect forward-looking costs. As GTE points out in its comments on Staff's Analysis:[14]

> "As the firm seeks to minimize costs over time, its embedded costs are simply a record of its efforts to optimize in past periods. It is reasonable to expect that in future periods it will continue to move along the same long-

[13] In the January, 1997 FCC workshops on proxy cost models, we found that three key input assumptions accounted for most of the difference between the Hatfield and BCM2 models: inclusion or exclusion of non-Bell territories, assumptions regarding the sharing of structures with non-telephone utilities, and the assignment of overhead costs.
[14] "GTE's Comments, p. 23.

run cost function. Unless there is some sharp, fundamental discontinuity in the underlying process, there is no reason to expect that costs in the near future will be dramatically different."

The primary reasons why booked costs would need to be adjusted to reflect forward looking costs are differences between economic and regulatory depreciation, and changes in input prices over time. Booked values for plant in service are affected by regulatory depreciation rates that likely reflect longer lifetimes than economic depreciation rates. At the very least, an adjustment to booked values is needed to reflect the true economic value of plant in service. If appropriate economic depreciation rates are used, differences due to changes in input prices will also be effectively captured.

Comparison of Proxy Model Results to GTE Economic Costs

We compare costs estimated by BCPM and HM3.1 for GTE territories in various states to GTE estimates of the monthly forward-looking economic cost per line. The following adjustments were made to GTE's local revenue requirement per loop per month to derive an estimate of GTE's forward-looking economic costs:

- all loop costs were moved to local
- a 11.25% rate of return was used for all jurisdictions
- effects of DEM weighting removed
- access revenues removed from the allocation of marketing expense
- adjustments made for changes due to CC Docket 96-128 (reclassification of pay phone assets) and CC Docket 80-286 (allocation of other billing and collection expenses)
- costs adjusted to reflect economic depreciation

The result of these adjustments is an estimate of GTE's monthly economic cost per line. This figure is compared to proxy model results to assess whether the proxy models are adequately capturing the true economic cost of providing service.

Table 1 compares GTE's adjusted monthly cost per line to the results of BCPM and HM3.1 for GTE territories in all states served by GTE. Because

Table 1
Comparison of Proxy Model Results to GTE Economic Costs

State	GTE	BCPM	HM31	BCPM/ GTE	HM3.1/ GTE
Alabama	$ 39.09	$ 59.68	$ 37.43	52.7%	-4.2%
Arizona	$ 26.27	$ 77.54	$ 68.63	195.2%	161.2%
Arkansas	$ 38.02	$ 62.19	$ 48.24	63.6%	26.9%
California	$ 38.68	$ 29.68	$ 17.64	-23.3%	-54.4%
Florida	$ 41.07	$ 34.03	$ 19.40	-17.1%	-52.8%
Hawaii	$ 44.71	$ 30.29	$ 21.13	-32.2%	-52.7%
Idaho	$ 42.84	$ 57.05	$ 28.64	33.2%	-33.1%
Illinois	$ 27.42	$ 47.28	$ 27.34	72.5%	-0.3%
Indiana	$ 35.66	$ 41.75	$ 24.14	17.1%	-32.3%
Iowa	$ 31.92	$ 66.12	$ 36.02	107.2%	12.9%
Kentucky	$ 40.70	$ 45.37	$ 25.34	11.5%	-37.7%
Michigan	$ 33.03	$ 48.69	$ 26.30	47.4%	-20.4%
Minnesota	$ 34.16	$ 69.82	$ 42.87	104.4%	25.5%
Missouri	$ 42.00	$ 59.89	$ 33.52	42.6%	-20.2%
N. Carolina	$ 46.46	$ 44.89	$ 26.96	-3.4%	-42.0%
Nebraska	$ 30.69	$ 57.62	$ 31.35	87.7%	2.2%
Nevada	$ 30.55	$ 52.43	$ 32.18	71.6%	5.3%
New Mexico	$ 39.91	$ 80.90	$ 43.43	102.7%	8.8%
Ohio	$ 32.11	$ 48.57	$ 25.04	51.2%	-22.0%
Oklahoma	$ 38.01	$ 47.79	$ 32.15	25.7%	-15.4%
Oregon	$ 34.93	$ 37.44	$ 21.24	7.2%	-39.2%
Pennsylvania	$ 30.55	$ 38.95	$ 24.80	27.5%	-18.8%
S. Carolina	$ 39.93	$ 47.75	$ 27.89	19.6%	-30.1%
Texas	$ 43.67	$ 44.11	$ 27.17	1.0%	-37.8%
Virginia	$ 36.14	$ 45.67	$ 26.32	26.4%	-27.2%
Washington	$ 38.13	$ 37.37	$ 20.85	-2.0%	-45.3%
Wisconsin	$ 32.37	$ 54.58	$ 29.35	68.6%	-9.3%
AVERAGE	**$ 37.90**	**$ 40.73**	**$ 23.82**	**7.5%**	**-37.2%**

HM3.1 estimates are only available for all GTE properties in a state combined, we combined all GTE properties in a state (primarily GTE and Contel) for the GTE economic cost estimates and for the BCPM proxy results to obtain an appropriate comparison of results. The percent difference in proxy model costs relative to GTE costs is also presented. The average at the bottom of the table is a weighted average, based on the number of lines accounted for by GTE properties in each state (as reported by GTE).

On average GTE's monthly cost per line is $37.90 across the 27 states studied. BCPM produces an average cost of $40.73 and HM3.1 produces an average cost of $23.82. On average BCPM costs are, thus, 7.5 percent greater than GTE economic costs and HM3.1 costs are 37.2 percent less than GTE economic costs. However, it is apparent that there is significant variation by state.

To analyze this variation, Table 2 orders the states according to the number of lines served by GTE properties in the state. We also divide the states into three groups, based on number of lines served by GTE.[15]

For the first tier of states (i.e., the largest GTE states), both BCPM and HM3.1 underestimate GTE's economic costs, on average. BCPM comes closer, understating GTE economic costs, on average, by 3 percent. HM3.1 underestimates GTE's economic costs by an average of over 43 percent. Both proxy models underestimate costs in GTE's two largest states, California and

[15] The Appendix presents the results ordered by the degree of underestimation by the proxy models.

Table 2
Comparison of GTE Cost to Proxy Model Costs
States Grouped by GTE Lines Served

State	Lines	GTE	BCPM	HM31	BCPM/ GTE	HM3.1/ GTE
California	4,012,527	$ 38.68	$ 29.68	$ 17.64	-23.3%	-54.4%
Florida	1,963,237	$ 41.07	$ 34.03	$ 19.40	-17.1%	-52.8%
Texas	1,522,540	$ 43.67	$ 44.11	$ 27.17	1.0%	-37.8%
Indiana	853,577	$ 35.66	$ 41.75	$ 24.14	17.1%	-32.3%
Illinois	828,995	$ 27.42	$ 47.28	$ 27.34	72.5%	-0.3%
Ohio	762,571	$ 32.11	$ 48.57	$ 25.04	51.2%	-22.0%
Washington	717,572	$ 38.13	$ 37.37	$ 20.85	-2.0%	-45.3%
Hawaii	674,283	$ 44.71	$ 30.29	$ 21.13	-32.2%	-52.7%
Michigan	674,084	$ 33.03	$ 48.69	$ 26.30	47.4%	-20.4%
Average	*1,334,376*	*$ 38.28*	*$ 37.05*	*$ 21.61*	*-3.2%*	*-43.5%*
Pennsylvania	586,621	$ 30.55	$ 38.95	$ 24.80	27.5%	-18.8%
Virginia	489,579	$ 36.14	$ 45.67	$ 26.32	26.4%	-27.2%
Kentucky	485,342	$ 40.70	$ 45.37	$ 25.34	11.5%	-37.7%
Wisconsin	441,903	$ 32.37	$ 54.58	$ 29.35	68.6%	-9.3%
Oregon	401,865	$ 34.93	$ 37.44	$ 21.24	7.2%	-39.2%
Missouri	387,127	$ 42.00	$ 59.89	$ 33.52	42.6%	-20.2%
N. Carolina	284,355	$ 46.46	$ 44.89	$ 26.96	-3.4%	-42.0%
Iowa	258,646	$ 31.92	$ 66.12	$ 36.02	107.2%	12.9%
Alabama	248,844	$ 39.09	$ 59.68	$ 37.43	52.7%	-4.2%
Average	*398,254*	*$ 36.59*	*$ 48.63*	*$ 28.04*	*32.9%*	*-23.4%*
Arkansas	186,052	$ 38.02	$ 62.19	$ 48.24	63.6%	26.9%
S. Carolina	181,636	$ 39.93	$ 47.75	$ 27.89	19.6%	-30.1%
Minnesota	113,504	$ 34.16	$ 69.82	$ 42.87	104.4%	25.5%
Idaho	113,027	$ 42.84	$ 57.05	$ 28.64	33.2%	-33.1%
Oklahoma	100,407	$ 38.01	$ 47.79	$ 32.15	25.7%	-15.4%
New Mexico	78,994	$ 39.91	$ 80.90	$ 43.43	102.7%	8.8%
Nebraska	53,433	$ 30.69	$ 57.62	$ 31.35	87.7%	2.2%
Nevada	28,654	$ 30.55	$ 52.43	$ 32.18	71.6%	5.3%
Arizona	6,856	$ 26.27	$ 77.54	$ 68.63	195.2%	161.2%
Average	*95,840*	*$ 37.92*	*$ 59.03*	*$ 36.95*	*55.7%*	*-2.6%*
AVERAGE		**$ 37.90**	**$ 40.73**	**$ 23.82**	**7.5%**	**-37.2%**

Florida. In California, BCPM underestimates GTE's economic costs by 23 percent and HM3.1 underestimates by 54 percent. In Florida, BCPM underestimates GTE's economic costs by 17 percent and HM3.1 underestimates by 53 percent. In fact HM3.1's greatest degree of underestimation occurs in these two states. Similarly, only Hawaii exhibits a greater degree of underestimation of BCPM costs relative to GTE costs. Generally, underestimation by HM3.1 is severe in the first-tier states. In contrast, BCPM overestimates GTE economic costs for many first-tier states, with estimates for Midwestern states being particularly high. In fact, BCPM generally produces very high estimates for Midwestern states, regardless of how many lines GTE serves.

For the second tier of states, BCPM overestimates GTE's economic costs, on average, by almost 33 percent and HM3.1 underestimates GTE's economic costs by an average of over 23 percent. Again, the pattern is one of BCPM generally producing overestimates and HM3.1 producing underestimates. For the third tier, BCPM overestimates by an average of almost 56 percent and HM3.1 underestimates by an average of almost 3 percent.

This grouping of states by GTE line count illustrates a clear pattern in the proxy model estimates. BCPM overestimation becomes greater for progressively smaller GTE states. HM3.1 underestimation becomes smaller for progressively smaller GTE states—i.e., HM3.1's most severe underestimation occurs in GTE's largest states.

Another state grouping that is relevant for determining how well the proxy models estimate relative costs is arranging the states by the level of GTE's economic costs. Table 3 orders the states according to GTE's monthly economic costs. The states are divided into three groups, based on GTE's costs.

Table 3
Comparison of GTE Cost to Proxy Model Costs
States Grouped by GTE Economic Costs

State	GTE	BCPM	HM31	BCPM/ GTE	HM3.1/ GTE
N. Carolina	$ 46.46	$ 44.89	$ 26.96	-3.4%	-42.0%
Hawaii	$ 44.71	$ 30.29	$ 21.13	-32.2%	-52.7%
Texas	$ 43.67	$ 44.11	$ 27.17	1.0%	-37.8%
Idaho	$ 42.84	$ 57.05	$ 28.64	33.2%	-33.1%
Missouri	$ 42.00	$ 59.89	$ 33.52	42.6%	-20.2%
Florida	$ 41.07	$ 34.03	$ 19.40	-17.1%	-52.8%
Kentucky	$ 40.70	$ 45.37	$ 25.34	11.5%	-37.7%
S. Carolina	$ 39.93	$ 47.75	$ 27.89	19.6%	-30.1%
New Mexico	$ 39.91	$ 80.90	$ 43.43	102.7%	8.8%
Average	*$ 42.48*	*$ 41.10*	*$ 24.32*	*-3.3%*	*-42.8%*
Alabama	$ 39.09	$ 59.68	$ 37.43	52.7%	-4.2%
California	$ 38.68	$ 29.68	$ 17.64	-23.3%	-54.4%
Washington	$ 38.13	$ 37.37	$ 20.85	-2.0%	-45.3%
Arkansas	$ 38.02	$ 62.19	$ 48.24	63.6%	26.9%
Oklahoma	$ 38.01	$ 47.79	$ 32.15	25.7%	-15.4%
Virginia	$ 36.14	$ 45.67	$ 26.32	26.4%	-27.2%
Indiana	$ 35.66	$ 41.75	$ 24.14	17.1%	-32.3%
Oregon	$ 34.93	$ 37.44	$ 21.24	7.2%	-39.2%
Minnesota	$ 34.16	$ 69.82	$ 42.87	104.4%	25.5%
Average	*$ 37.79*	*$ 36.23*	*$ 21.64*	*-4.1%*	*-42.7%*
Michigan	$ 33.03	$ 48.69	$ 26.30	47.4%	-20.4%
Wisconsin	$ 32.37	$ 54.58	$ 29.35	68.6%	-9.3%
Ohio	$ 32.11	$ 48.57	$ 25.04	51.2%	-22.0%
Iowa	$ 31.92	$ 66.12	$ 36.02	107.2%	12.9%
Nebraska	$ 30.69	$ 57.62	$ 31.35	87.7%	2.2%
Nevada	$ 30.55	$ 52.43	$ 32.18	71.6%	5.3%
Pennsylvania	$ 30.55	$ 38.95	$ 24.80	27.5%	-18.8%
Illinois	$ 27.42	$ 47.28	$ 27.34	72.5%	-0.3%
Arizona	$ 26.27	$ 77.54	$ 68.63	195.2%	161.2%
Average	*$ 30.93*	*$ 48.94*	*$ 27.29*	*58.2%*	*-11.8%*
AVERAGE	**$ 37.90**	**$ 40.73**	**$ 23.82**	**7.5%**	**-37.2%**

Table 3 indicates that BCPM costs are relatively close to GTE economic costs, on average, for the highest cost and middle tier of states, underestimating costs by an average of 3 percent for the highest cost states and 4 percent for the second tier. Of course, there is significant variation by state. By contrast, HM3.1's most severe underestimation of costs occurs for the highest cost GTE states and is almost the same, on average, for the second tier of states. In both instances, HM3.1 underestimates GTE economic costs, on average, by over 42 percent. With very few exceptions, HM3.1 consistently underestimates costs in the first and second tier of states.

In the lowest-cost tier of states, BCPM significantly overstates costs. On average BCPM overstates costs by 58 percent. as it consistently overstates costs over all states. On the other hand, the degree of HM3.1 understatement is lowest in the low-cost states. On average, HM3.1 underestimates GTE economic costs by almost 12 percent for these states.

The grouping of states by line size and cost level produces discernible patterns of the degree by which the proxy models misstate GTE economic costs. One proposed use of proxy models is to determine relative cost relationships for distributing Universal Service funds to high-cost areas. It has been proposed that this be done at a level of disaggregation below the study area of a company, such as the Census Block Group (CBG) level. The variation in proxy costs relative to GTE economic costs we have observed at the state level indicates that care must be taken to ensure that proxy models are providing accurate information regarding relative cost relationships at any level, whether it be statewide study areas or CBGs.

Other External Validation Measures

In addition to a comparison of economic costs, there are a number of other validation activities that could be performed. One activity we have been able to perform here is a comparison of line counts produced by the models with actual GTE line counts.

Table 4
Comparison of GTE Line Counts to Proxy Model Line Counts

State	GTE	BCPM	HM31	BCPM/ GTE	HM3.1/ GTE
California	4,012,527	4,695,972	3,996,872	17.0%	-0.4%
Florida	1,963,237	1,509,450	2,018,410	-23.1%	2.8%
Texas	1,522,540	1,754,787	1,638,607	15.3%	7.6%
Indiana	853,577	986,230	867,830	15.5%	1.7%
Illinois	828,995	1,074,505	825,045	29.6%	-0.5%
Ohio	762,571	857,020	906,381	12.4%	18.9%
Washington	717,572	773,138	718,342	7.7%	0.1%
Hawaii	674,283	712,743	653,310	5.7%	-3.1%
Michigan	674,084	770,373	677,402	14.3%	0.5%
Average	*1,334,376*	*1,459,357*	*1,366,911*	*9.4%*	*2.4%*
Pennsylvania	586,621	717,034	802,920	22.2%	36.9%
Virginia	489,579	573,751	488,669	17.2%	-0.2%
Kentucky	485,342	395,649	586,570	-18.5%	20.9%
Wisconsin	441,903	474,672	440,846	7.4%	-0.2%
Oregon	401,865	389,348	403,237	-3.1%	0.3%
Missouri	387,127	383,422	437,140	-1.0%	12.9%
N. Carolina	284,355	300,697	438,951	5.7%	54.4%
Iowa	258,646	285,433	259,534	10.4%	0.3%
Alabama	248,844	291,207	265,322	17.0%	6.6%
Average	*398,254*	*423,468*	*458,132*	*6.3%*	*15.0%*
Arkansas	186,052	233,010	215,503	25.2%	15.8%
S. Carolina	181,636	186,821	221,839	2.9%	22.1%
Minnesota	113,504	128,108	115,355	12.9%	1.6%
Idaho	113,027	103,863	113,993	-8.1%	0.9%
Oklahoma	100,407	112,154	112,306	11.7%	11.9%
New Mexico	78,994	33,959	80,328	-57.0%	1.7%
Nebraska	53,433	53,762	52,873	0.6%	-1.0%
Nevada	28,654	31,196	28,764	8.9%	0.4%
Arizona	6,856	6,726	7,329	-1.9%	6.9%
Average	*95,840*	*98,844*	*105,366*	*3.1%*	*9.9%*
AVERAGE	**609,490**	**660,557**	**643,470**	**8.4%**	**5.6%**

Table 4 presents a comparison of line counts for GTE relative to the GTE estimates of BCPM and HM3.1. On average, both proxy models overestimate GTE's line counts, with a great degree of variability across states. BCPM overestimates to the greatest degree in the larger states, while HM3.1's greatest overestimates occur in the second tier of states.

In addition, a detailed engineering analysis could be undertaken to assess the accuracy of the models in laying out their networks. For example, specific serving areas for various density groups could be independently analyzed by a group of expert network engineers and the results of each proxy model could be compared to this standard. Additionally, statistics on loop miles or other physical measures of the network could be compared with the model results to determine if the network layout produced by the models is adequate.

An engineering evaluation on the current versions of the proxy models, BCPM and HM3.1, has been recently performed by Price Technical Services, Inc. and Austin Communications Education Services, Inc (Price/Austin). Regarding the BCPM, the Price/Austin evaluation concluded that the BCPM satisfies substantially all the requirements of the Joint Board and that the flexibility of the model allows changes to reflect input values the FCC and the Joint Board believe to be appropriate.[16] The Price/Austin evaluation concluded that while HM3.1 is an improvement over HM2.2.2, there are several outstanding problems and shortcomings that preclude the use of the HM 3.0/3.1 in any real world design or cost analysis.[17]

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[16] "Engineering Evaluation of Cost Proxy Models For Determining Universal Service Support: Benchmark Cost Proxy Model," Price Technical Services, Inc., and Austin Communications Education Services, Inc., February 23, 1997, p. 19.
[17] "Engineering Evaluation of Cost Proxy Models For Determining Universal Service Support: Hatfield Model Version 3.0/3.1," Price Technical Services, Inc., and Austin Communications Education Services, Inc., March 17, 1997, p. 38.

V. Conclusion

The comparison of proxy model results to GTE's forward-looking economic costs gives rise to concern not only over the use of proxy models to determine cost levels, but also over the use of proxy models for determining relative cost relationships. The Hatfield model generally underestimates economic cost, while BCPM generally overestimates economic costs. We also found that the proxy models' deviation from economic cost is related to the number of lines served in the state and to the level of economic cost . Even if Universal Service funds are distributed at a level below the statewide study area, such as the CBG level, our analysis indicates that care must be taken if proxy models are used to provide information on relative cost relationships for the purpose of distributing Universal Service funds.

Appendix

Comparison of Proxy Model Estimates to GTE Economic Cost